Capturing Phrases for ICU-Talk, A Communication Aid for Intubated Intensive Care Patients.

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ABSTRACT

The need for intubated patients, within the intensive care setting, to communicate more effectively led to the development of ICU-Talk, an augmentative and alternative communication aid. The communication aid contains a database containing both core and patient-specific vocabulary. Many users of communication aids can provide direct input into the vocabulary, but intensive care patients are not in this position. This paper discusses the methods chosen to gather the vocabulary for an intensive care setting.

Keywords

Communication, AAC, ICU, Vocabulary

BACKGROUND

The ICU-Talk project is a three-year multidisciplinary project, which has developed a computerised communication aid for patients in an intensive care unit (ICU). This is a specialised area within a hospital that provides a high level of care for a specific group of patients. These patients are critically ill and normally require to be ventilated and closely monitored. Each ICU varies in size with normally 7 to 10 beds and very high staffing levels that provide a nurse for each patient. The patient's length of stay can be unpredictable and depends on many variables; diagnosis, prognosis, underlying general health, any infection present and nutritional requirements. ICU has a variety of high tech monitoring equipment, which can alert nurses and doctors to emergencies. Each patient has a life support machine and monitoring equipment round their bed (Figure 1). The typical ICU environment can be noisy as the majority of equipment is alarmed and busy with medical, nursing and support personnel.

Figure 1 - ICU Environment

This ICU-Talk project was faced with many challenges, given the specialised environment and the user group. For the majority of the time the patients in ICU are sedated and unable to speak due to the placement of an endotracheal tube. This process is referred to as intubation and facilitates mechanical ventilation until the patient can maintain his or her own ventilation. However there is a time when the patients are not sedated but still intubated, this varies from a few hours to a few days. Patients at this stage are awake, alert and attempting to communicate. Their ability to communicate effectively can be impaired, due to various factors, such as generalised weakness, fatigue, cognitive impairment and poor memory. Communicating with intubated patients is difficult, time consuming and frustrating for both patients and nursing staff [1,3]. Research suggests that nurses have difficulty communicating effectively with alert, intubated patients [2,6,12]. This is mainly due to the patient's inability to vocalise and to use the current methods of communication adequately. These methods include alphabet boards, symbol charts and writing with pen and paper. None of these methods have been designed for ICU patients.

ICU-Talk is an augmentative and alternative communication (AAC) aid specifically designed to address factors relating to the patient in ICU. A simple, interesting, intuitive and easy to learn system was required. The changing condition of the patient meant that various input

devices such as touch screen, scanning and mouse emulation were required [7]. ICU-Talk contains a database of prestored sentences, questions and phrases that the patient can select. Upon selection the chosen phrase is spoken via a speech synthesizer. This database is provided for all users of the aid.

Most users of communication aids have time to become familiar with the capabilities of their device. They can have a direct input into the vocabulary that can be utilised in the aid. The patients in ICU are not able to do this. This paper will discuss the methods chosen to gather the vocabulary that provided the prestored database.

METHODS

Due to the patient's inability to provide vocabulary for the aid, alternative sources had to be found. These included the nursing staff in ICU, observing patient's attempts to communicate and utilising the patient's next of kin.

The nursing staff in ICU were asked to provide at least three examples of observed attempts of communication by intubated patients from a variety of conversation topics. 75% of the nurses were surveyed and over 200 phrases, sentences and questions were obtained. Reorganisation of the results gave 190 unique phrases which formed the prestored database. In order to verify that these were the actual phrases that the patients were attempting to communicate, an observation tool was developed. Researchers from the team observed communication attempts by ICU patients and compared them to the prestored database. Each observation session varied from one to three hours and was performed during the day. The patients' communication attempts were recorded, along with the method of communication used and whom they were communicating with. Twelve patients were observed over a thirty-hour period. Only 47 of the 190 prestored phrases were attempted in communications by patients. The other observed communication attempts were specific to the individual patients. This outcome identified the need to provide phrases that were relevant to individual patients.

Due to their illness, the patients are not in a position to contribute to the personalisation of their prestored database. An excellent source of information about the patient is their next of kin or a close friend [7]. One of the methods commonly used to obtain such information is for a nurse to spend some time with the next of kin or friend and ask questions about the patient. This can be time consuming for both the nurse and the patient's next of kin/friend. Interruptions, finding a suitable time and location for both parties, asking each set of relatives the same questions, not being too personal or taking too long are some of the things which make this process of interviewing difficult.

A consistent and quick, easy to complete interview was necessary. This also had to include a method of transferring the information into phrases automatically.

The Computer Interview

As ICU-Talk is a computerised aid, the possibility of a computer-based interview was explored. Previous applications of computer-based interviewing [8] were consulted before developing the interview tool. The tool transforms the answers obtained from the interview into phrases that are added to the patients' database automatically, thereby personalising it.

Developing the interview tool involved four stages:

1. Determining the kind of personalised phrases to include.
2. Construction of the appropriate interview questions.
3. Creation of the computer-based interview's layout.
4. Generation of phrases from the answers.

1. Determining the Kind of Personalised Phrases to Include.
By examining the results obtained from the observations it could be seen that patients attempted to communicate certain things about their family, friends and general interests. The following are examples of communication attempts from intubated patients:

- "Where is Jenny?"
- "Phone Sheila."
- "How is Lorna?"
- "I enjoy gardening."

These attempts at communication helped to generate phrases that could be used in the ICU-Talk aid. The examples shown are all taken from four different patients. Three examples show the patient asking about someone important to them. The fourth example is making a statement about a particular interest. These helped to form the basis for generating personal phrases for each patient. For example as one of the patients is asking "Where is Jenny?" phrases generated from this were "How is Jenny?" and "Could you tell Jenny to come and see me?" If the patient were to use this phrase with their next of kin or close friend then that individual would know who Jenny was. As the patient can have a different nurse looking after them each day, they may not be aware who Jenny is. Therefore as part of the interview questions, the interviewee is asked to define the patient's relationship with certain individuals. This detailed information can be easily printed out and attached to the patient's notes accompanying them throughout their hospital stay.

A selection of personal phrases was created for each subject, e.g. family, friends, religion and hobbies. If the patient had a child who was of school age a possible phrase for that patient to use is "How did (child's name) get on at school today?" To create such a phrase the child's age would need to be obtained. This was determined by asking the relative to choose an age range for each child that the patient had. If the patient had a baby, again the phrase that

this patient would maybe like to ask is "Who is looking after (child's name)?"

A total number of thirteen questions were created relating to the patient's family and friends, their hobbies and interests, if they like television or radio, if they play the lottery, if they have any pets and their religion. A maximum of 80 phrases are created if all the questions are completed fully.

2. Construction of the Appropriate Interview Questions.

Having identified potential phrases, the questions were then compiled to give the expected answer to produce the personalised phrases (Figure 2). For example, a possible phrase is "Who is looking after (child's name)?" Therefore, the question created was "Does the patient have any children?" If yes then the interviewee completes a small section which asks for the names of the patient's children along with their ages.

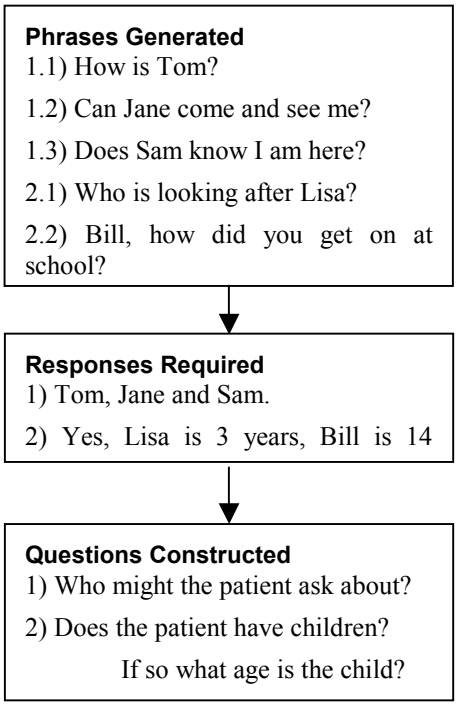

Figure 2 - Approach taken to Construct Questions

3. Creation of the Computer-Based Interview's Layout.

The interview layout was designed to be simple to use and provide a feeling of familiarity. Census forms and household surveys were examined for their content and structuring of questions. Some of the questions were incorporated into the computer interview to provide a familiarity of questioning for the interviewee. An introduction was provided about the interview and its purpose. A page was included to allow the interviewee to practice the techniques used to answer questions, e.g. drop-down menus and tick boxes. The interview was divided into different numbered "pages" providing a consistent theme to the interface [10]. This provided the interviewee with an indication of the length of the interview. At the bottom of each page, a "back" and "next" button was provided for the interviewee to navigate through the interview. There is a small "thank you" section at the end of the interview. There is no time limit for the interview and the interviewee can go back and alter answers, as they feel necessary. The interview does not infringe on nursing time and can be completed at any time by the patient's next of kin or close friend.

4. Generation of Phrases from the Answers.

The interview was created in a Microsoft Access database using the embedded Visual Basic for Applications programming language. Once all the questions were answered, the phrases had to be generated. This was done by inserting the appropriate answers into skeleton templates of the phrases. For example, if you had the phrase "How is X?" and the interviewee had answered "Lorna" as a child of the patient, then X would be replaced by Lorna to give the phrase "How is Lorna?" Another example of this can be seen with an interview question that asks if the patient likes to play the lottery. If the interviewee answers "yes" then three phrases are added to the patient's database; "What are this week's lottery numbers?", "Have I won the lottery?" and "Can you put the lottery on for me please?"

Thus, the interview tool gathers information from the patient's next-of-kin and adds phrases to the ICU-Talk database.

Capturing Phrases - The Future

The ICU-Talk database contains phrases that are pre-stored or generated from the information provided via the interview tool. Both sources provide a useful, yet restricted set of phrases. The phrases in the database for any particular patient are fixed. This becomes increasingly significant as the patient's length of stay in ICU is prolonged and they want to talk about topics unrelated to their medical condition. These may include, for example, interests in the latest news, favourite television soap or a sports team.

To address this issue, research undertaken by the postgraduate student, on the project, focused on how to provide the patients with a broader range of up-to-date phrases and a means of following events taking place outside the hospital. This work offers a new and unique feature for future versions of ICU-Talk.

Previous research with phrase generation for AAC devices has looked at variety of techniques including word prediction to assist the user in creating phrases [11] and using cogeneration approaches to aid phrase completion [5]. The ICU-Talk interview tool provides a means of automatically creating phrases using information gathered from the patient's next of kin. This new tool creates phrases based on the current affair information of interest to the

patient. These phrases are added to the ICU-Talk database for that patient.

With the ever-increasing size of the World Wide Web and the increasing amount of information available to the user, it seemed only logical that this information should be utilised. The web acts like an extended database that provides current information to create phrases for the patient to use. The tool takes a list of the patient's interests, from the information entered via the interview tool, and it searches the web for news articles that may be of interest to the patient. Once an article is found, a brief summary is automatically generated from it. A method of extraction-based summarisation is used to identify sentence(s) that contain the essence of the text [4,9]. These sentences then form the basis of any phrases generated.

EMPIRICAL RESEARCH

A crucial step in this phrase formation is identification of the summarising sentence in the original article. To determine whether this was being achieved, an experiment was designed to measure how effective the tool was compared to humans at identifying the correct sentence.

The experiment involved a group of 20 volunteers selected using volunteer and opportunity sampling. Each participant had to analyse a news article and identify three sentences that they believed summarised the text. Once identified, they would rank these sentences in order of importance, i.e. the sentence that was the best at summarising the text would be ranked the most important, followed by the next sentence and finally the least appropriate sentence. The participants were then asked to rank three sentences, selected by the tool, using the same principle. This process of ranking was then repeated with another two sets of three sentences selected by the tool using different algorithms. This process was repeated with three news articles selected randomly, from different categories, from the online British Broadcasting Corporation (BBC) news site. The order in which the participants received the news articles and the set of computer-selected sentences was randomised to eliminate any effects of learning and boredom. At the time of writing, the experiment is ongoing. The findings will be described at the conference presentation.

CONCLUSION

Most users of augmentative and alternative communication (AAC) aids have time to become familiar with the capabilities of their device. They can have a direct input into the vocabulary that can be utilised in the system. Due to the intensive care unit (ICU) patient's inability to provide the vocabulary for the ICU-Talk system, alternative sources had to be used. These included the nursing staff in ICU, observing patient's attempts to communicate and utilising the patient's next of kin. Two sets of vocabulary were created; a core database containing phrases general to all the patients and a patient database containing phrases specific to each individual.

The core database was gathered by asking the nursing staff to provide phrases that they believe would be suitable for the ICU patients. Patients in ICU were then observed to determine if this set of phrases was suitable. The completion of observations gave a revised set of phrases that now constitute as the core database.

The patient database required information from the patients regarding the personalised phrases they required. Since this was not possible, the next best approach was using the patient's next-of-kin as a source of information. A computer-based interview tool was developed that guided the patient's next-of-kin through a structured interview forming an immediate set of phrases unique to the individual patients. To date four people have used the interview, they were able to complete it quickly without any assistance. A current-affairs tool was also developed that generates phrases relevant to the patient's interests, thus allowing them to communicate about topics unrelated to their medical condition.

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